



DEFENSE TECHNICAL INFORMATION CENTER

Information for the Defense Community

DTIC® has determined on 31 / 5 / 2013 that this Technical Document has the Distribution Statement checked below. The current distribution for this document can be found in the DTIC® Technical Report Database.

☒ **DISTRIBUTION STATEMENT A.** Approved for public release; distribution is unlimited.

☐ **© COPYRIGHTED.** U.S. Government or Federal Rights License. All other rights and uses except those permitted by copyright law are reserved by the copyright owner.

☐ **DISTRIBUTION STATEMENT B.** Distribution authorized to U.S. Government agencies only (fill in reason) (date of determination). Other requests for this document shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT C.** Distribution authorized to U.S. Government Agencies and their contractors (fill in reason) (date determination). Other requests for this document shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT D.** Distribution authorized to the Department of Defense and U.S. DoD contractors only (fill in reason) (date of determination). Other requests shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT E.** Distribution authorized to DoD Components only (fill in reason) (date of determination). Other requests shall be referred to (insert controlling DoD office).

☐ **DISTRIBUTION STATEMENT F.** Further dissemination only as directed by (insert controlling DoD office) (date of determination) or higher DoD authority.

Distribution Statement F is also used when a document does not contain a distribution statement and no distribution statement can be determined.

☐ **DISTRIBUTION STATEMENT X.** Distribution authorized to U.S. Government Agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoDD 5230.25; (date of determination). DoD Controlling Office is (insert controlling DoD office).



DEPARTMENT OF DEFENSE
WASHINGTON HEADQUARTERS SERVICES
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155



MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER
(ATTN: WILLIAM B. BUSH)
8725 JOHN J. KINGMAN ROAD, STE 0944
FT. BELVIER, VA 22060-6218

JUL 25 2013

SUBJECT: OSD MDR Case 13-M-2857

At the request of [REDACTED], we have conducted a Mandatory Declassification Review of the attached document under the provisions of Executive Order 13526, section 3.5, for public release. We have declassified the document in in part. We have attached a copy of our response to the requester. If you have any questions, please contact Ms. Luz Ortiz by e-mail at luz.ortiz@whs.mil, luz.ortiz@osd.smil.mil, or luz.ortiz@osdj.ic.gov or by phone at 571-372-0478.

Robert Storer
Chief, Records and Declassification Division

Attachments:

1. MDR request
2. OSD response letter
3. Document 1





DEPARTMENT OF DEFENSE
WASHINGTON HEADQUARTERS SERVICES
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155



Subject: OSD MDR Case 13-M-2857

JUL 25 2013

Dear [REDACTED]:

We have reviewed the enclosed document in consultation with the Department of the Air Force (USAF) and National Aeronautics and Space Administration (NASA). USAF and NASA have no objection to declassification in full. However, OSD has declassified it in part. The excised information is exempt from declassification under Executive Order 13526, section 3.3(b)(4) and (8) and is also protected under the Freedom of Information Act (FOIA), 5 U.S.C. § 552(b)(6).

- Section 3.3(b)(4) protects information that would impair the application of state-of-the-art technology within a U.S. weapon system.
- Section 3.3(b)(8) protects information that would seriously impair current national security emergency preparedness plans or reveal current vulnerabilities of systems, installations, or infrastructures relating to the national security.
- FOIA, 5 U.S.C. § 552(b)(6) protects information which would constitute a clearly unwarranted invasion of the personal privacy of certain individuals.

OSD stands as the appellate authority and will coordinate any appeals regarding this case. A written appeal must be filed within 60 days explaining the rationale for reversal of the decision. Reference should be made to OSD MDR Case 13-M-2857. Letters of appeal should be sent to the following address:

WHS/ESD Records and Declassification Division
Attention: Luz Ortiz
4800 Mark Center Drive
Suite 02F09-02
Alexandria, VA 22350-3100

If you have any questions, contact Ms. Luz Ortiz by e-mail at Records.Declassification@whs.mil.

Sincerely,

Robert Storer
Chief, Records and Declassification Division

Enclosures:

1. MDR request
2. Document 1

20130730539



~~SECRET~~

AD596231

Apollo 16 Launch Measurements (U)

Office of the Secretary of Defense 5015 5052
Chief, RDD, ESD, WHS +
Date: 22 JUL 2013 Authority: EO 13526
Declassify: _____ Deny in Full: _____
Declassify in Part: X
Reason: 3.3(b)(4)(8) + 5 U.S.C. 5552(b)(6)
MDR: 13 -M- 2857

MASSACHUSETTS INST OF TECH LEXINGTON

09 NOV 1972

Defense Advanced Research Projects Agency, Attn: ASBD-TIO, 3701
North Fairfax Drive, Arlington, VA 22203-1714. 31 Jul 1974.

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~SECRET~~

Att 2

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

Redistribution Of DTIC-Supplied Information Notice

All information received from DTIC, not clearly marked "for public release" may be used only to bid on or to perform work under a U.S. Government contract or grant for purposes specifically authorized by the U.S. Government agency that is sponsoring access OR by U.S. Government employees in the performance of their duties.

Information not clearly marked "for public release" may not be distributed on the public/open Internet in any form, published for profit or offered for sale in any manner.

Non-compliance could result in termination of access.

Reproduction Quality Notice

DTIC's Technical Reports collection spans documents from 1900 to the present. We employ 100 percent quality control at each stage of the scanning and reproduction process to ensure that our document reproduction is as true to the original as current scanning and reproduction technology allows. However, occasionally the original quality does not allow a better copy.

If you are dissatisfied with the reproduction quality of any document that we provide, please free to contact our Directorate of User Services at (703) 767-9066/9068 or DSN 427-9066/9068 for refund or replacement.

Do Not Return This Document To DTIC

~~SECRET~~

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JUL 22 2013

~~AD- 596231~~
~~SECURITY REMARKING REQUIREMENTS~~
~~DOD 5205.1-R, DEC 78~~
~~REVIEW ON 09 NOV 92~~

SECURITY MARKING

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JUL 22 2013

The classified or limited status of this report applies
to each page, unless otherwise marked.

Separate page printouts **MUST** be marked accordingly.

~~THIS DOCUMENT CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF
THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18,
U.S.C., SECTIONS 793 AND 794. THE TRANSMISSION OR THE REVELATION OF
ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY
LAW.~~

NOTICE: When government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related government procurement operation, the U. S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto.

✓

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

AD596231

Project Report

AOR-25

Apollo 16 ~~Launch~~ Measurements
(Title UNCLASSIFIED)

H. J. Bullwinkel
R. H. Ellis

9 November 1972

Prepared for the Advanced Research Projects Agency
under Electronic Systems Division Contract F19628-73-C-0002 by

Lincoln Laboratory

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LEXINGTON, MASSACHUSETTS



NOV 1972
2013

~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

Do not announce in TAB.

~~All dissemination controlled by ARIA/TIO.~~

~~Secret~~

~~Secret~~

This document comprises
50 pages. No. 63
of 145 copies.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

LINCOLN LABORATORY

APOLLO 16 ~~Launch~~ MEASUREMENTS

(Title UNCLASSIFIED)

H. J. BULLWINKEL

Philco-Ford Corporation

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

R. H. ELLIS

Group 52

PROJECT REPORT AOR-25
(ARPA Optics Research)

9 NOVEMBER 1972

This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C. Sections 793 and 794. The transmission or the revelation of its contents in any manner to an unauthorized person is prohibited by law.

EXCLUDED FROM GDS
(DD Form 254 GP 3)

Do not announce in TAB.

~~All distribution controlled by ARPA/TIO.~~

DOC CONTROL
NO. 22720

LEXINGTON

MASSACHUSETTS

~~Secret~~

13M-2857

In addition to this document
and ~~its contents~~ ~~which~~ ~~are~~ ~~being~~ ~~transmitted~~ ~~by~~ ~~air~~ ~~mail~~ ~~only~~
ARPA/TIO NO. 22720

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2019

The work reported in this document was performed at Lincoln Laboratory, a center for research operated by Massachusetts Institute of Technology. This work was sponsored by the Advanced Research Projects Agency of the Department of Defense under Air Force Contract F19628-73-C-0002 (ARPA Order 600).

~~Secret~~

(This page is UNCLASSIFIED)

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(8)

~~ABSTRACT~~

(S) During mission ETR 1601, excellent long wave infrared [REDACTED] data [REDACTED] were obtained during the launch phase of Apollo 16 by the Lincoln Laboratory NKC-135 aircraft. Infrared hard body, core and plume measurements, primarily of Apollo 16 second stage (S-II) and early third stage (S-IVB) operation, were obtained during a seven minute continuous data coverage interval.

(S) The LWIR tracker-radiometer acquired the Apollo 16 second stage (S-II) [REDACTED] when the vehicle was at an altitude of [REDACTED] and a range of [REDACTED]

(S) Excellent second stage plume data were recorded by the LWIR tracker from [REDACTED]

~~Secret~~

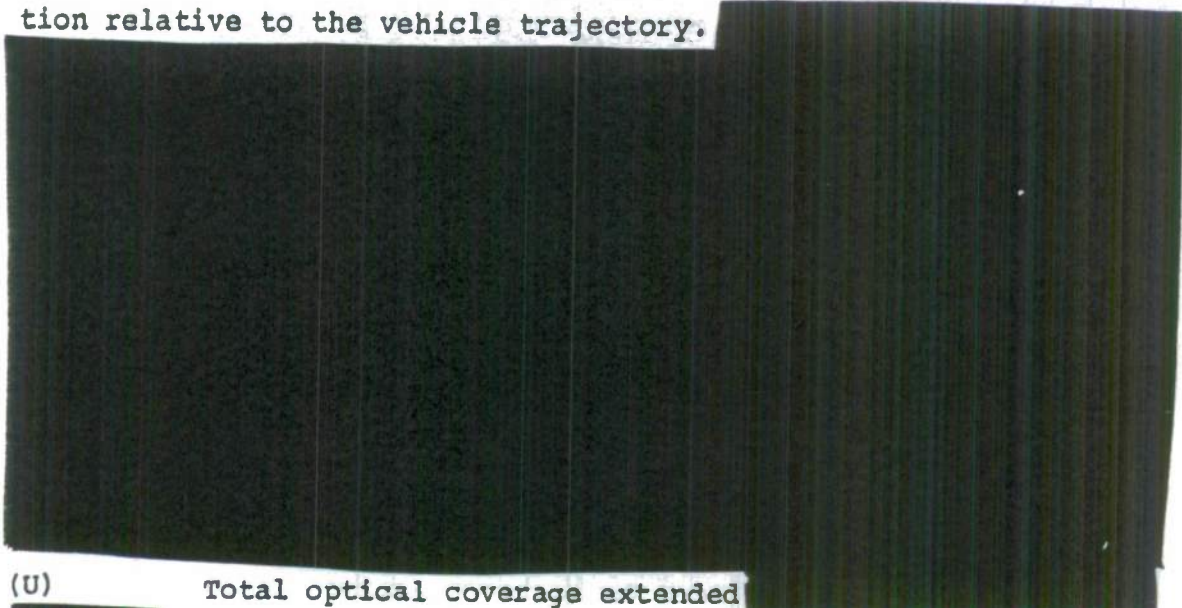
~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

TEST DESCRIPTION

(U) The Apollo 16 space vehicle, ETR 1601, was launched from complex 39A at the Kennedy Space Center, Florida, on 16 April 1972 at 17:54:00Z. The launch phase, which occurred during cloudless weather conditions, consisted of the complete burn of the S-1C and the S-II stages and a partial burn of the S-IVB stage of the Saturn V launch vehicle. OSD 3.3(b)(4)(8)

(U) Figure 2 shows the location of the airborne instrumentation relative to the vehicle trajectory.



(U) Total optical coverage extended [redacted] with data being obtained on the S-I^r and S-IVB stages. Characteristics of the data collecting instruments are listed in Appendix A. Metric data, which includes plots of the Apollo 16 nominal angle of attack, as well as the look angle and elevation angle measurements relative to the KC-135 aircraft, are presented in Appendix 3.

~~Secret~~

(This page is UNCLASSIFIED)

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(8)

INTRODUCTION

(S) This report deals primarily with infrared data obtained during the launch phase of Apollo 16 by the Lincoln Laboratory

[REDACTED]

A plot of the relative spectral response of each of the instruments is presented in Fig. 1. A summary of the characteristics of both instruments is presented in Appendix A.

(S) The Apollo 16 S-II and S-IVB stages provided excellent targets for the study of infrared hard-body and plume radiation. Approximately 1300 samples of long wavelength data were obtained during the seven minutes of optical coverage. During this mission the prime objective of the instrumented NKC-135 aircraft was to obtain long wavelength optical data during second stage burn with the point of greatest interest occurring at second stage cut-off. This objective was successfully accomplished.

(U) The data presented in this report represents a sampling of the abundant data obtained during this mission. Several frames, selected at representative phases of the Apollo's plume history, have been presented in detail. Throughout this report, an expanded caption format is used to allow the reader to compare explanatory information with the accompanying illustrations.

(U) *The characteristics of the LWIR tracker-radiometer have been described at several Midcourse Measurement Meetings^{1,2,3} and in several previous AOR's 5,6,7.

(U) **Both instruments were described at the 1971 annual IRIS meeting.⁴

~~Secret~~

~~Secret~~

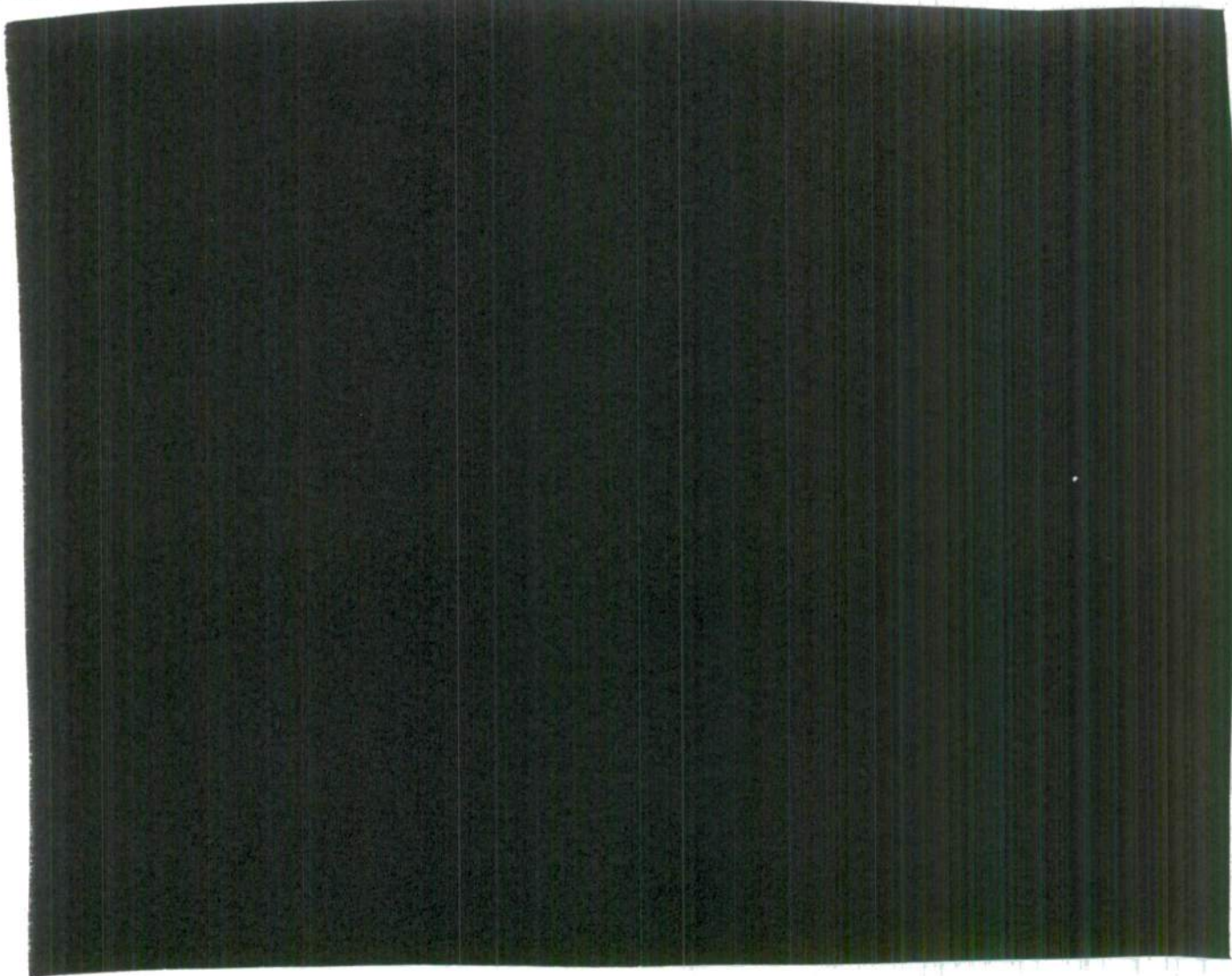
DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~(S)~~ A pictorial display of 96 representative frames, from the more than 1300 data frames collected by the LWIR instrument during this mission, are presented in the final portion of this report.

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

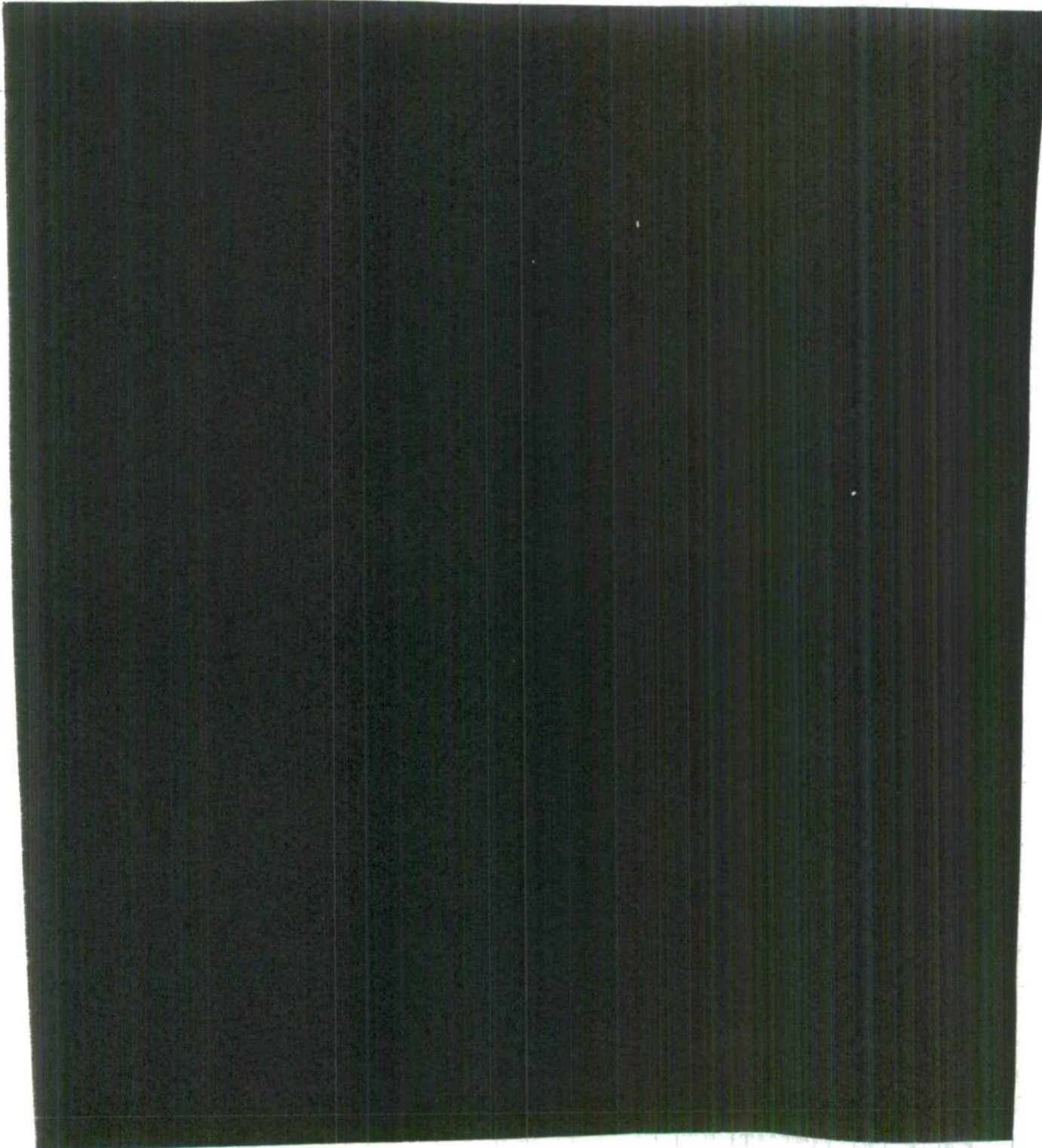


OSD 3.3(b)(4),(8)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013



OSD 3.3(b)(4)(B)

~~Secret~~

(This page is UNCLASSIFIED)

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 3

(S) Figure 3 presents the Apollo 16 altitude and range to the aircraft as well as a brief event summary. The LWIR tracker-radiometer acquired the Apollo second stage (S-II) at an altitude of [REDACTED] and a range of [REDACTED]. The SWIR (1 μ m-6 μ m) spatial radiometer obtained data between TAL [REDACTED] and TAL [REDACTED]. Stage II thrust termination occurred at TAL [REDACTED] and third stage (S-IVB) ignition began at TAL [REDACTED].

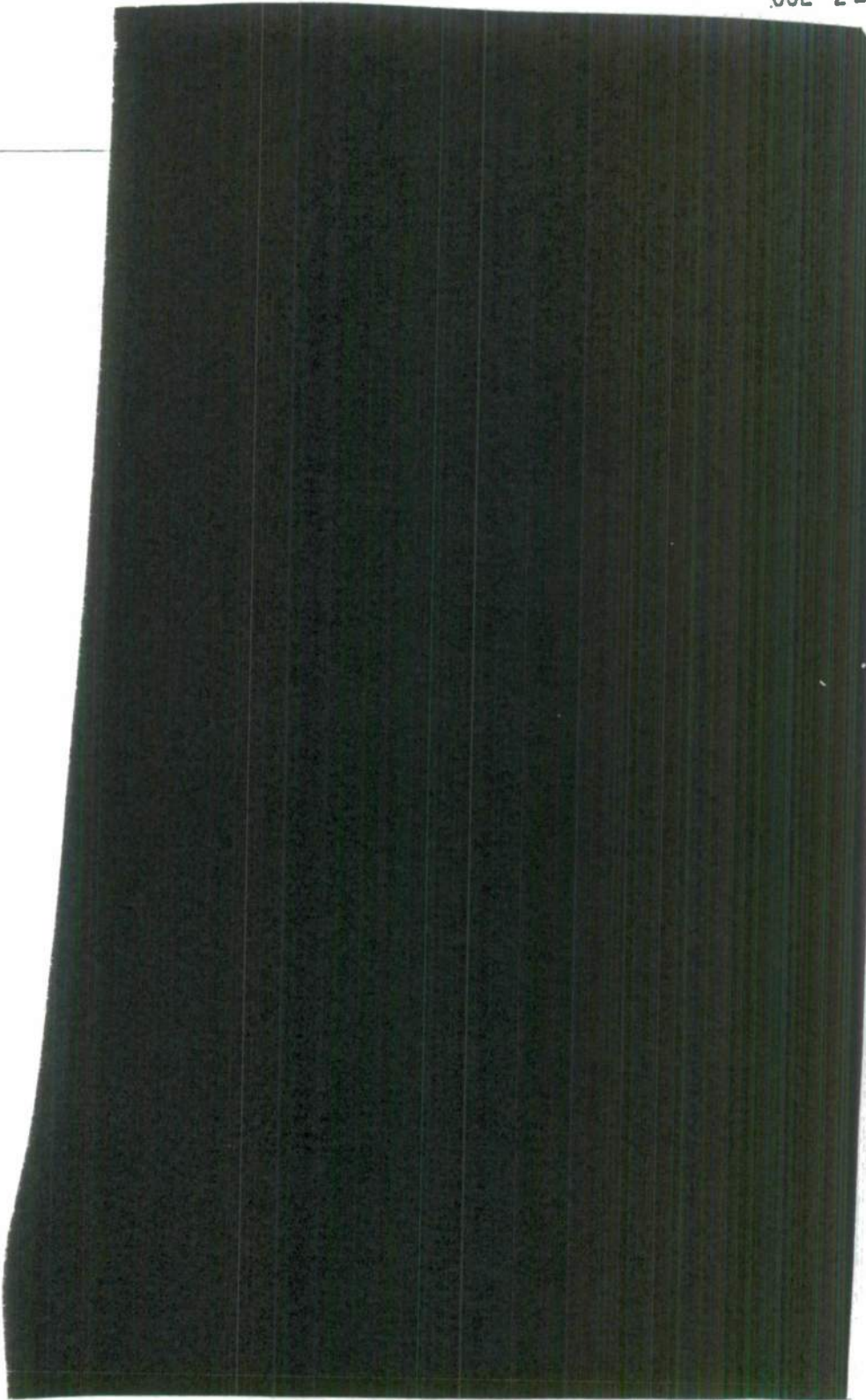
OSD 3.3(b)(4),(b)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(5)



~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 4

(S) Figure 4 presents an example of one of the more than 1300 data frames obtained by the 16mm film record of the LWIR C-scope display. The C-scope data is a "TV" type display of the serialized output of the scanned 176 cell array ($3.4^\circ \times 3.4^\circ$ FOV). The lower edge of the paraboloid-shaped bow-shock is the primary observable. The apparent high intensity of the lower portion of the plume is caused by the missile angle of attack and possibly the atmospheric density gradient. The apparent attitude of 45° is caused by a combination of gimbaled mirror angles, look angle (34°) and angle of attack (18°). The striated structure of the plume, as yet unexplained, is of considerable interest to aerodynamicists.

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

TAL
ALT
RANGE



Figure 4

OSD 3.3(b)(4)(B)

~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

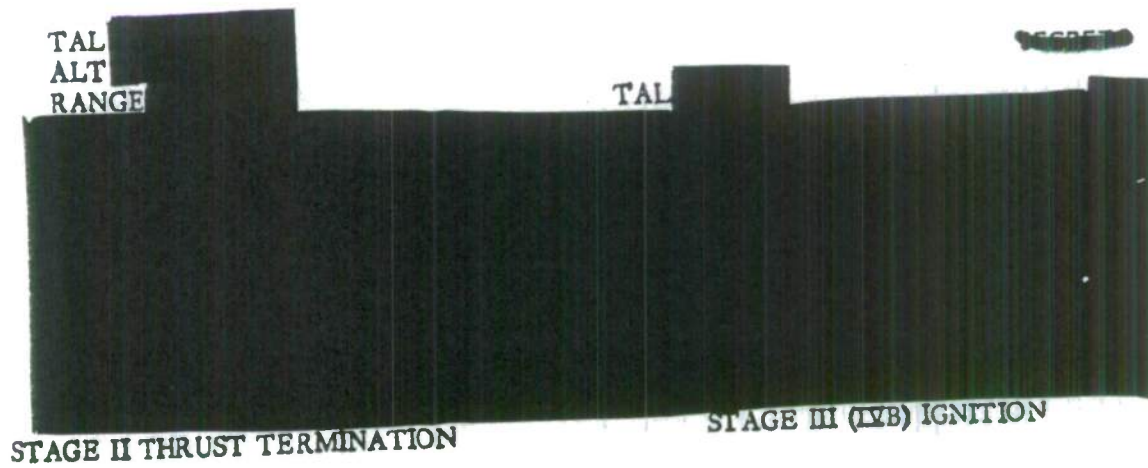
FIGURE 5

~~(S)~~ Figure 5 presents two samples of LWIR C-scope data which show thrust termination of the S-II stage and ignition of the S-IVB stage. At thrust termination gaps appear in the missile plume structure indicating the loss of H_2O from the engine even though the bow-shock excitation remains available. The lack of persistence in the plume radiation is obvious, as compared with reentry trails.

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013



LWIR C-SCOPE IMAGES

Figure 5

OSD 3.3(b)(4)(B)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 6

(S) Figure 6 presents another sample of the LWIR C-scope display, showing the Stage III (S-IVB) plume and the spent Stage II plume. [REDACTED] The more intense portion of Stage III [REDACTED] The striated S-II plume structure, seen in Fig. 3, was not observed in the S-IV plume.

OSD 3.3(b)(4),(8)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

TAL
ALT
RANGE



OSD 3.3(b)(4),(s)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date:

JUL 22 2013


FIGURE 7

(S) Figure 7 presents a composite of three modes of LWIR data obtained on the S-II and S-IVB stages at three selected times. Plume radiant intensities are presented in each of the three samplings. Calibrated peak detector outputs, are shown on the top row, whereas calibrated iso-radiance contours and C-scope display photographs are shown in the two lower rows. All calibrated levels were determined from digitally recorded star and planet data.

(U) The peak detector levels represent the maximum intensity of each resolution element in the azimuth scan and correspond to the ridge peak values of the contour map directly below. The C-scope photographs shown in the bottom row, represent a "TV" type display of the serialized output of the scanned 176 cell array (3.4° x 3.4° FOV).

(S) The more intense lower edge of the paraboloid shaped plume, which is evidenced in each of the data frames, is attributed to the vehicle's angle of attack and possibly the atmospheric density gradient.

(S) Radiant intensity values for both the S-II and S-IVB were obtained by integrating over the entire radiation within the field-of-view at each of the three selected intervals. Stage II



OSD 3.3(b)(4),(6)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(6)

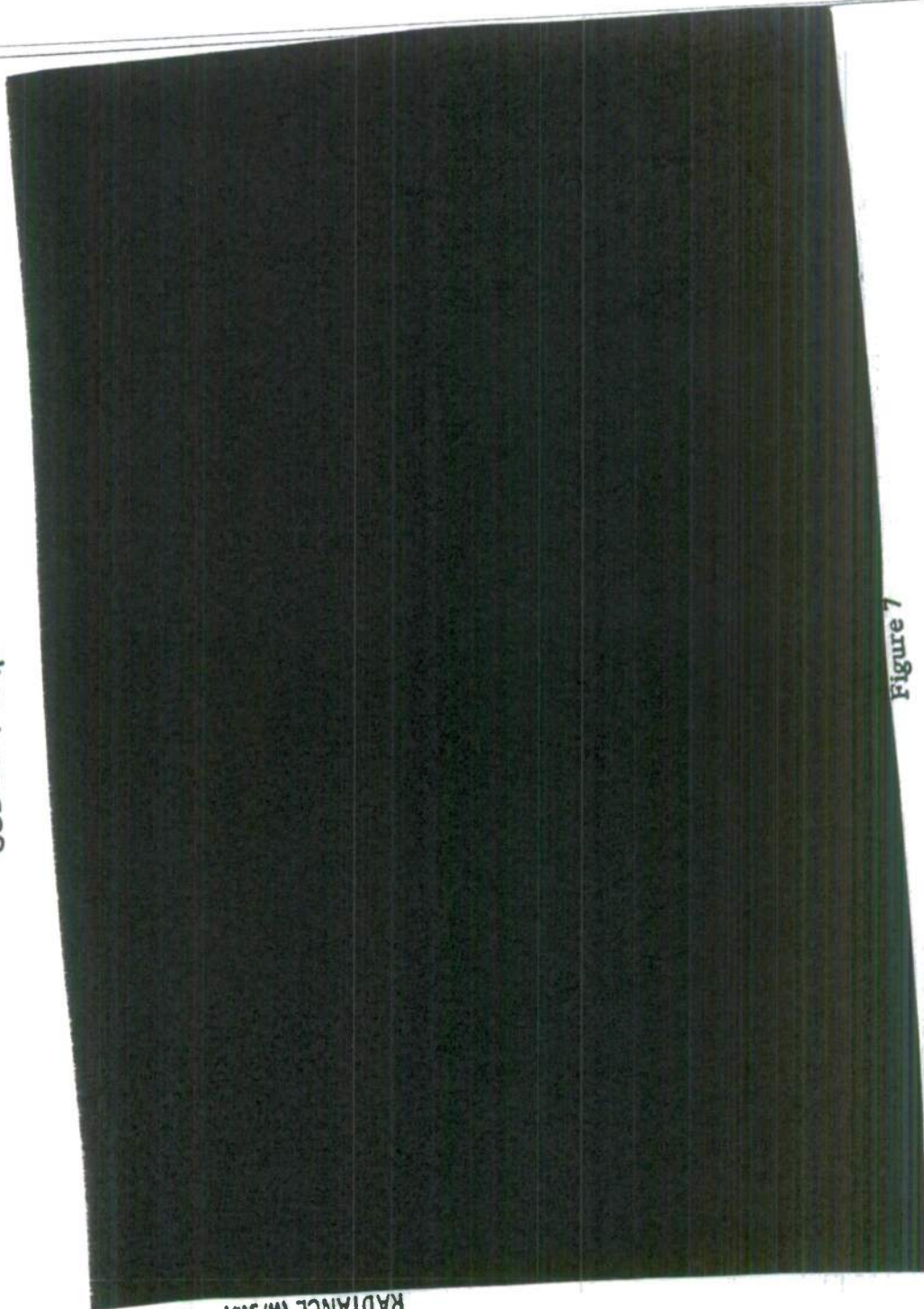


Figure 7

RADIANCE (w/ster - m²)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 8

(S) Figure 8 presents the LWIR radiant intensity histories of the unresolved S-II and S-IVB stage cores and the spent S-II hard body. The intensities were determined from the peak detected output. All values were computed from the instruments' signal to noise ratios based on irradiance from Jupiter, Mars, Mercury, Venus and the star α -Orion. The period over which the core radiation was saturated should be noted. No data are presented after [REDACTED] due to uncertainties introduced by superimposed plume radiation.

(S) As the data illustrate, core radiation of the S-II,



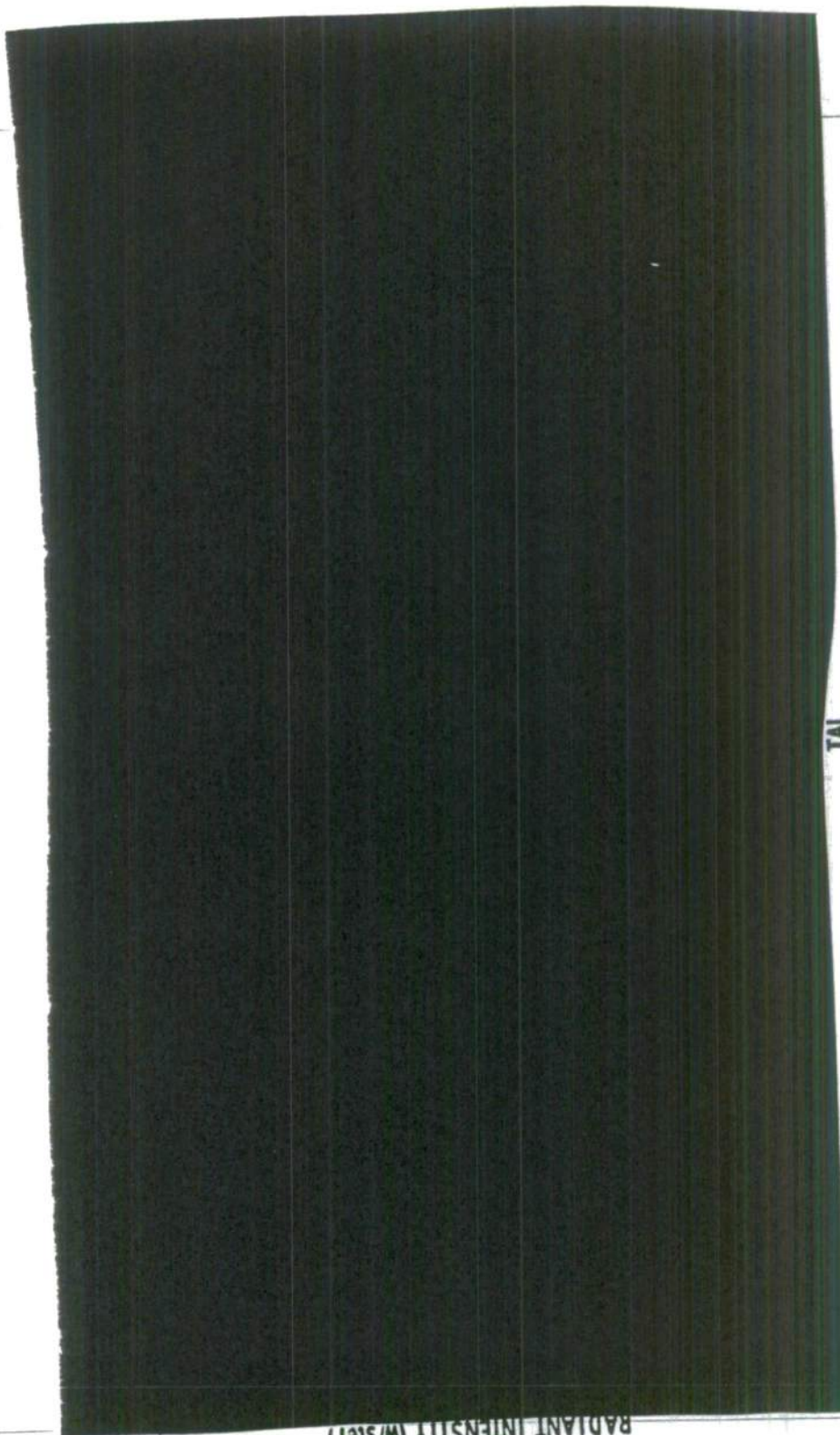
OSD 3.3(b)(4),(5)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(B)



TAL

RADIANT INTENSITY HISTORIES

Figure 8

RADIANT INTENSITY (w/ster)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 9

Figure 9 presents a plot of S-II stage peak plume radiance as a function of velocity. The intensities were derived from peak detector measurements obtained between TAL [REDACTED] and TAL [REDACTED].

The data shows a gradual increase in intensity from [REDACTED] to a maximum value of [REDACTED] at termination of Stage II thrust at [REDACTED].

Although the data appear to fit a v^2 dependence, it should be noted that the data have not been corrected for atmospheric absorption. At early acquisition, when the target was at a range of [REDACTED] from the aircraft, the effects of an increase in background due to atmospheric radiation as well as signal absorption would be quite severe.

OSD 3.3(b)(4)(8)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(b)

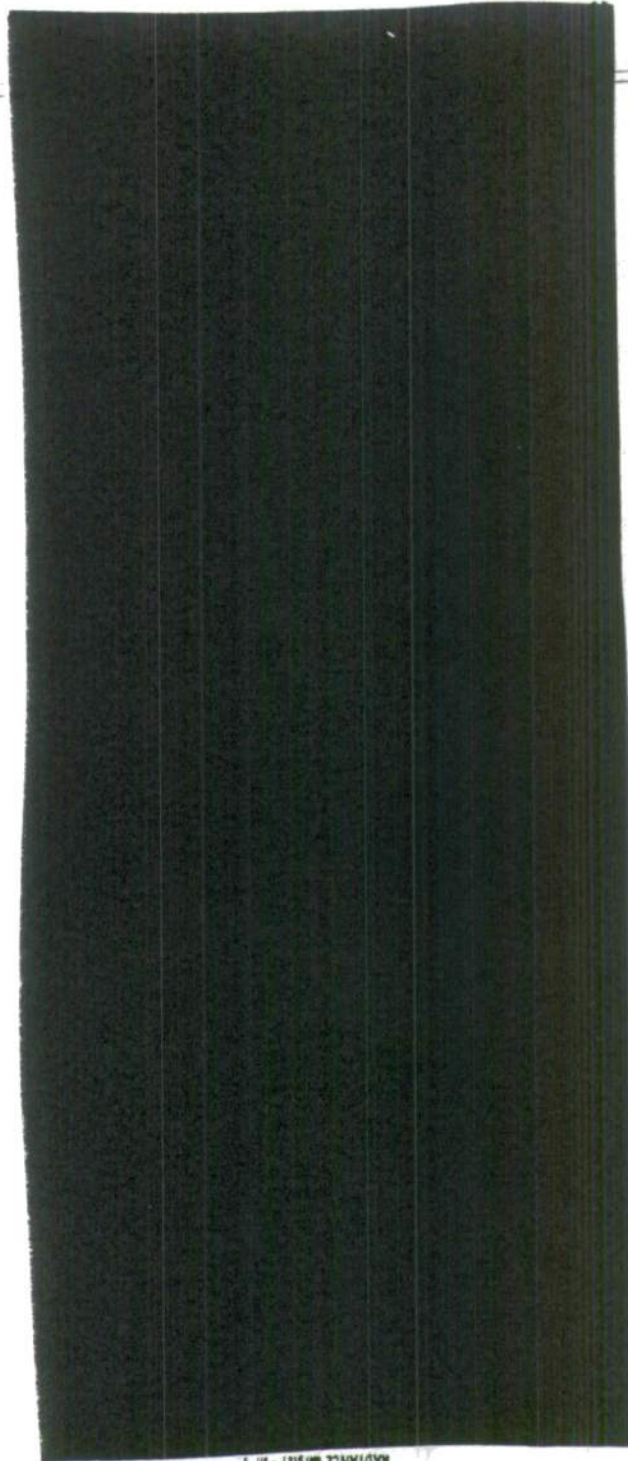


Figure 9

RADIANCE $\text{W/m}^2 \cdot \text{m}^2$

~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 10

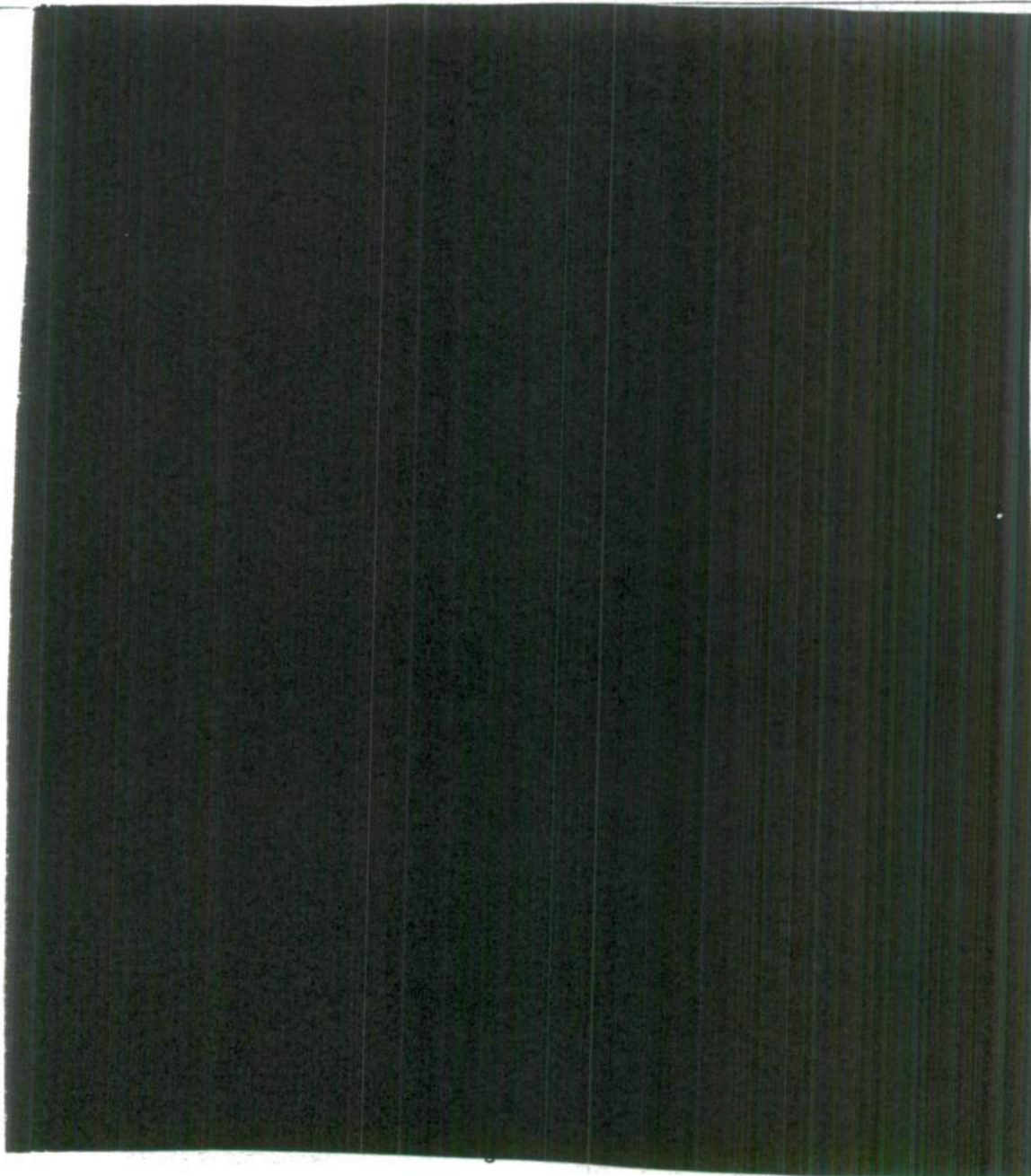
(S) Figures 10 through 17 present additional samples of the 16 mm film record of the C-scope display of the LWIR tracker-radiometer data. These are presented in order to give the reader a pictorial history of the S-II and S-IVB stage events as they occurred during the data coverage period. The C-scope display pictures also provide the only LWIR data when the quantitative data are saturated.

(S) A composite of twelve frames of the C-scope display, representative of the first minute of data coverage, are presented in Fig. 10. These data show the steady intensity increase of Stage II and the gradual development of the striated structure of the plume.

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013



OSD 3.3(b)(4),(8)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 11

(S) Figure 11 presents twelve representative C-scope frames showing the continued development of the Stage II [REDACTED] [REDACTED] Evidence of electronic overshoot, which has characteristically been associated with the LWIR tracker-radiometer, is present throughout this sequence.

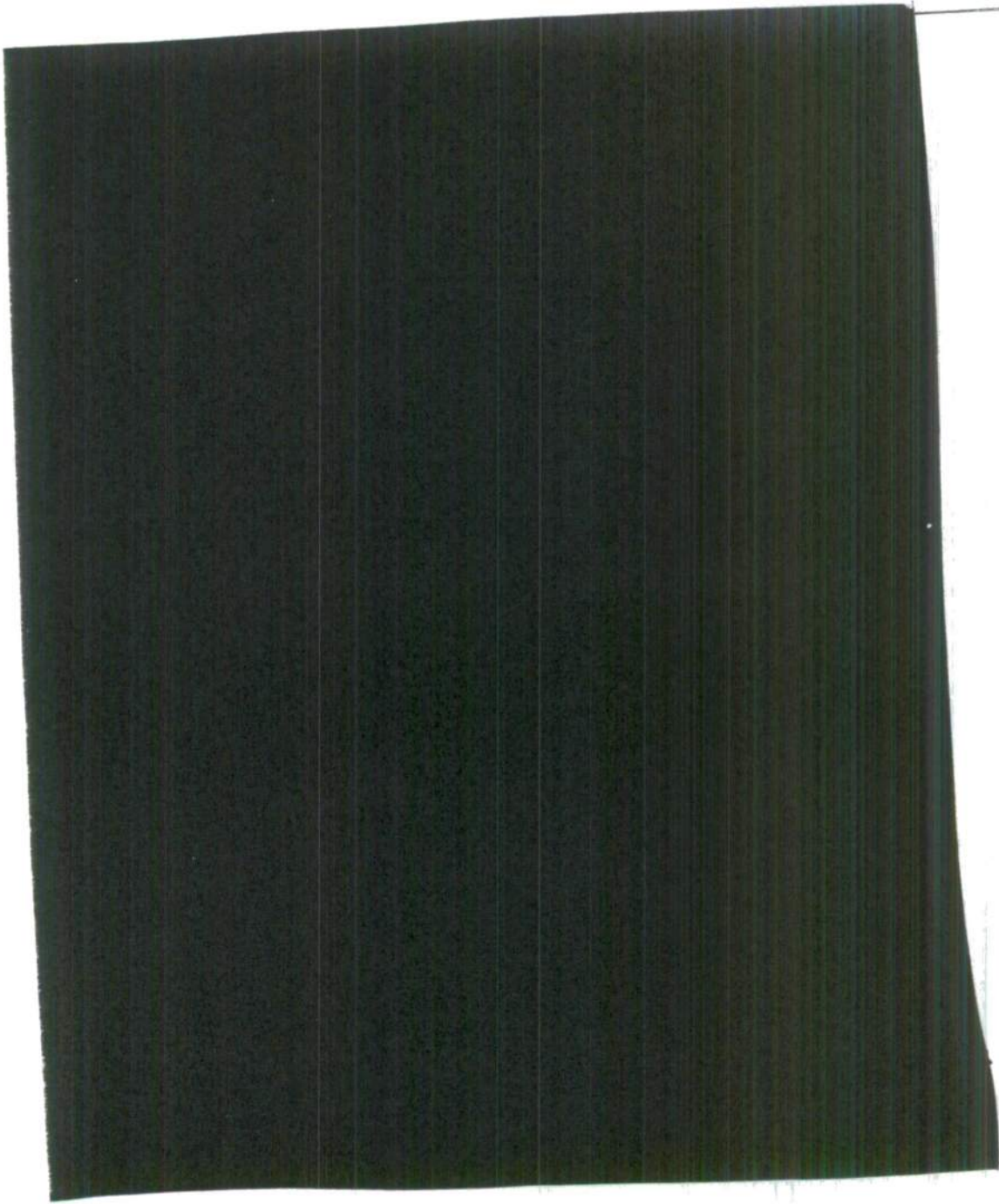
OSD 3.3(b)(4),(6)

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4),(8)



~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 12

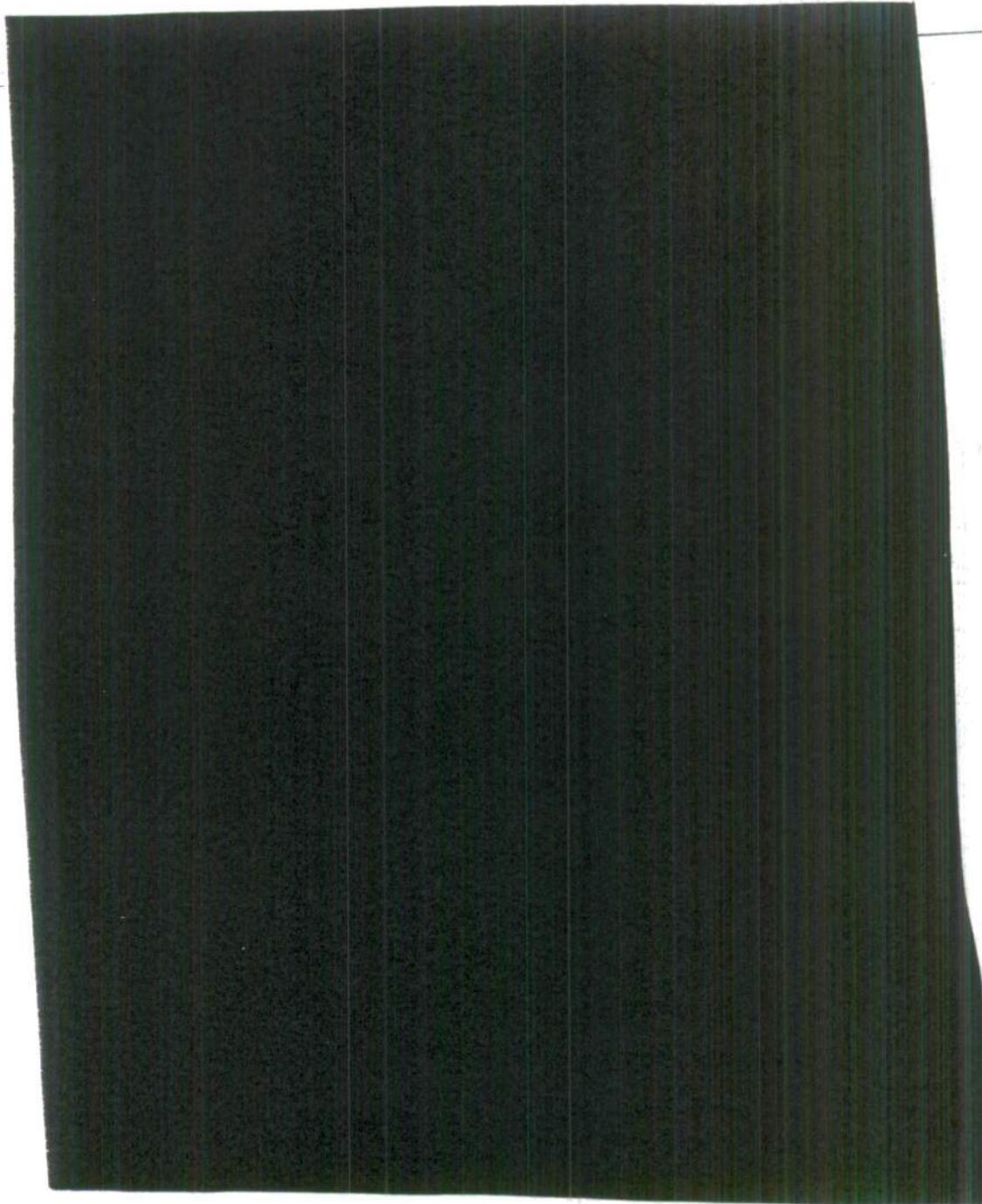
Figure 12 presents a sequence of twelve successive C-scope frames showing the LWIR history of Stage II just prior to Stage III ignition. The plume is now shown enveloping the vehicle on all sides. Variations of the location of the data in the data frames are due to aircraft maneuvering at this time.

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

OSD 3.3(b)(4)/(8)



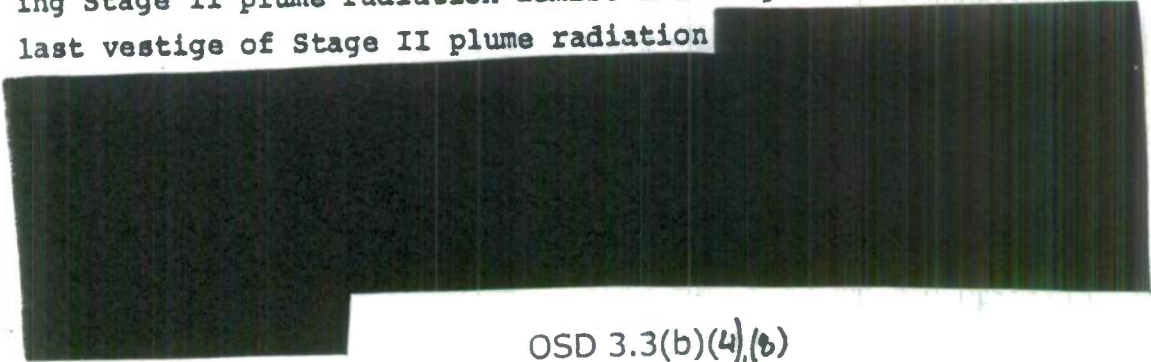
~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 13

(S) Figure 13 presents a sequence of C-scope frames showing Stage II plume radiation demise and Stage III ignition. The last vestige of Stage II plume radiation



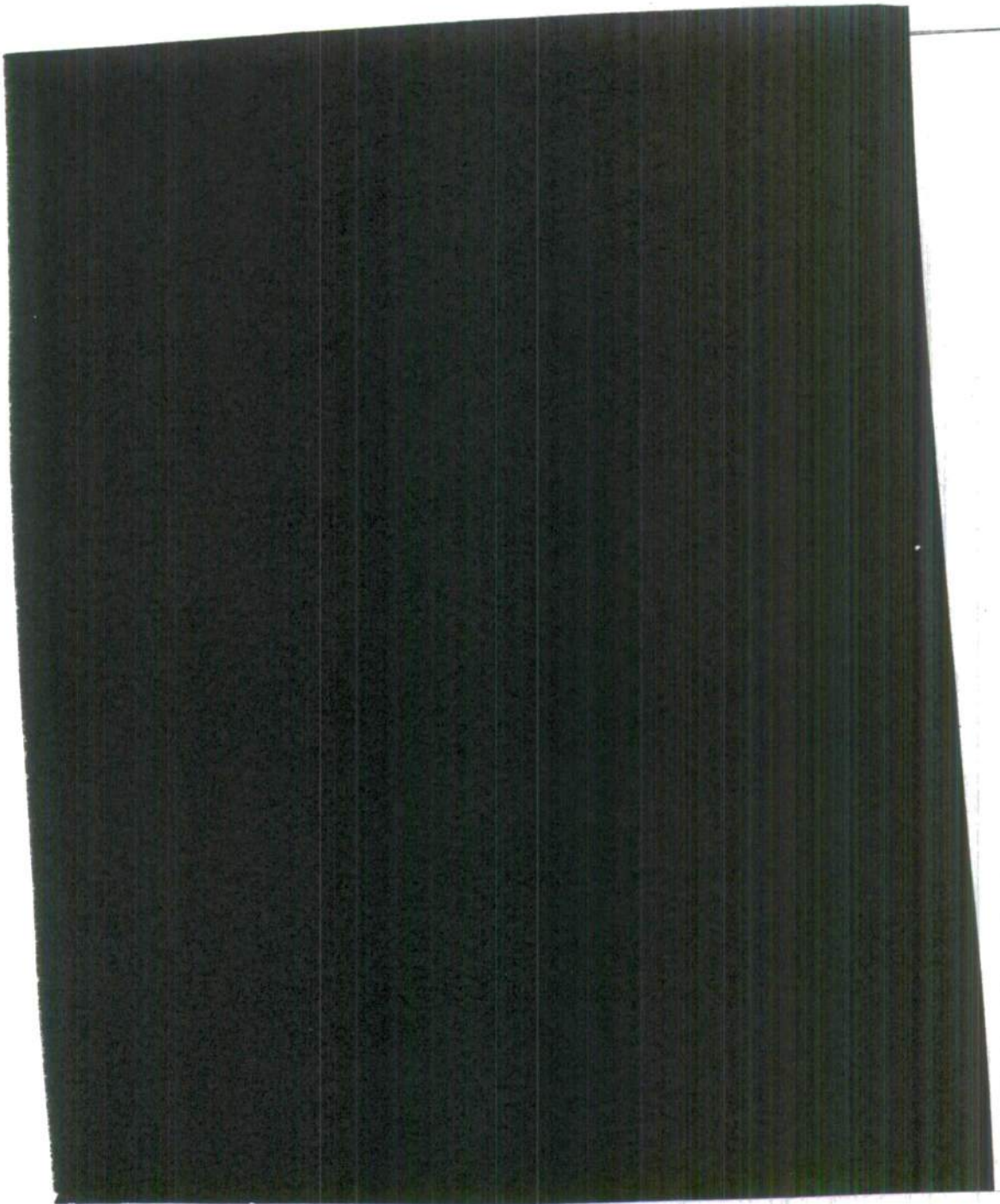
OSD 3.3(b)(4),(b)

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

OSD 3.3(b)(4)(b)



~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

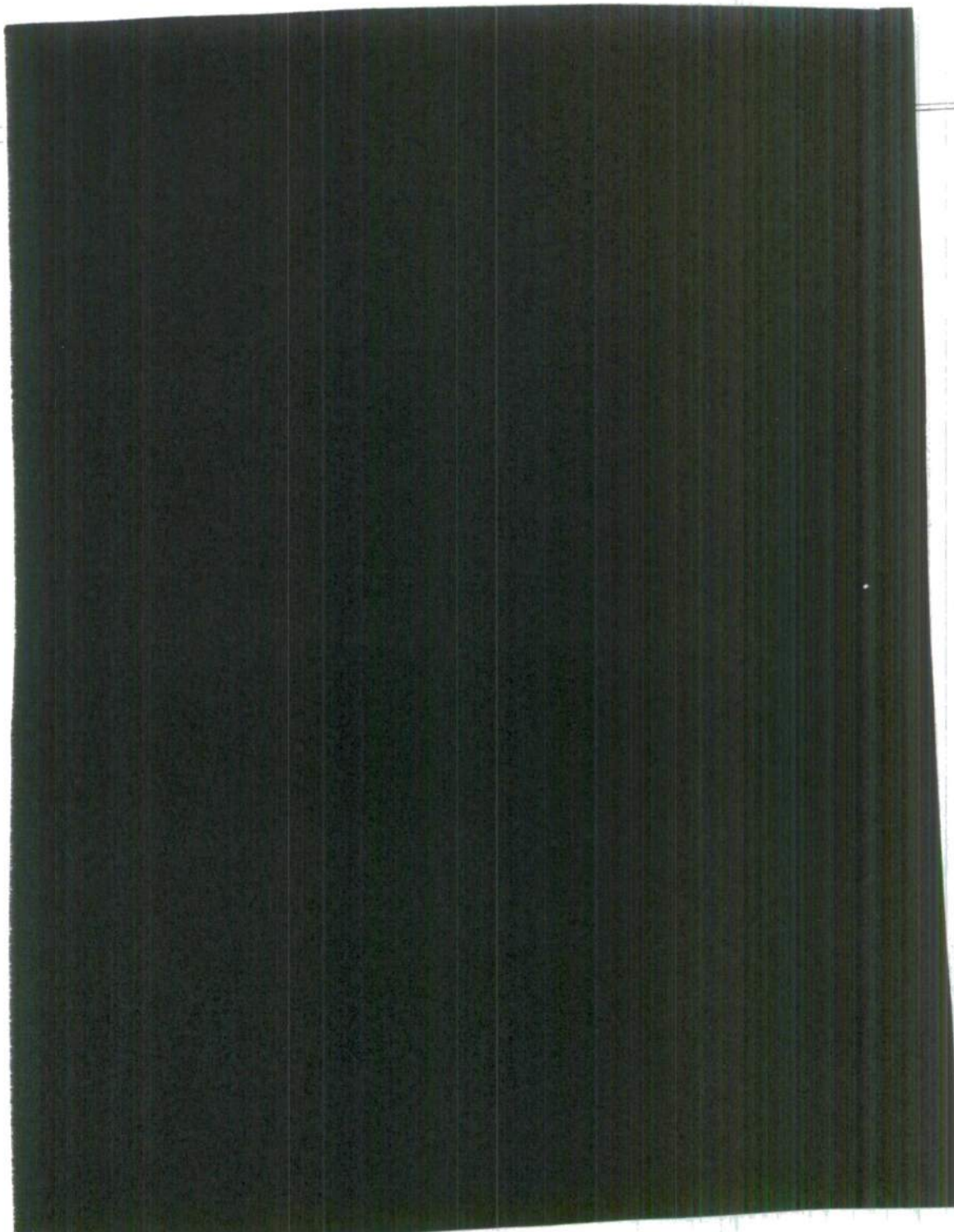
FIGURE 14

~~(S)~~ Figure 14 presents a series of twelve C-scope display frames showing Stage III hard body and plume radiation as well as the spent Stage II vehicle falling behind.

~~Secret~~

~~Secret~~

OSD 3.3(b)(4)/(8)



DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

FIGURE 15

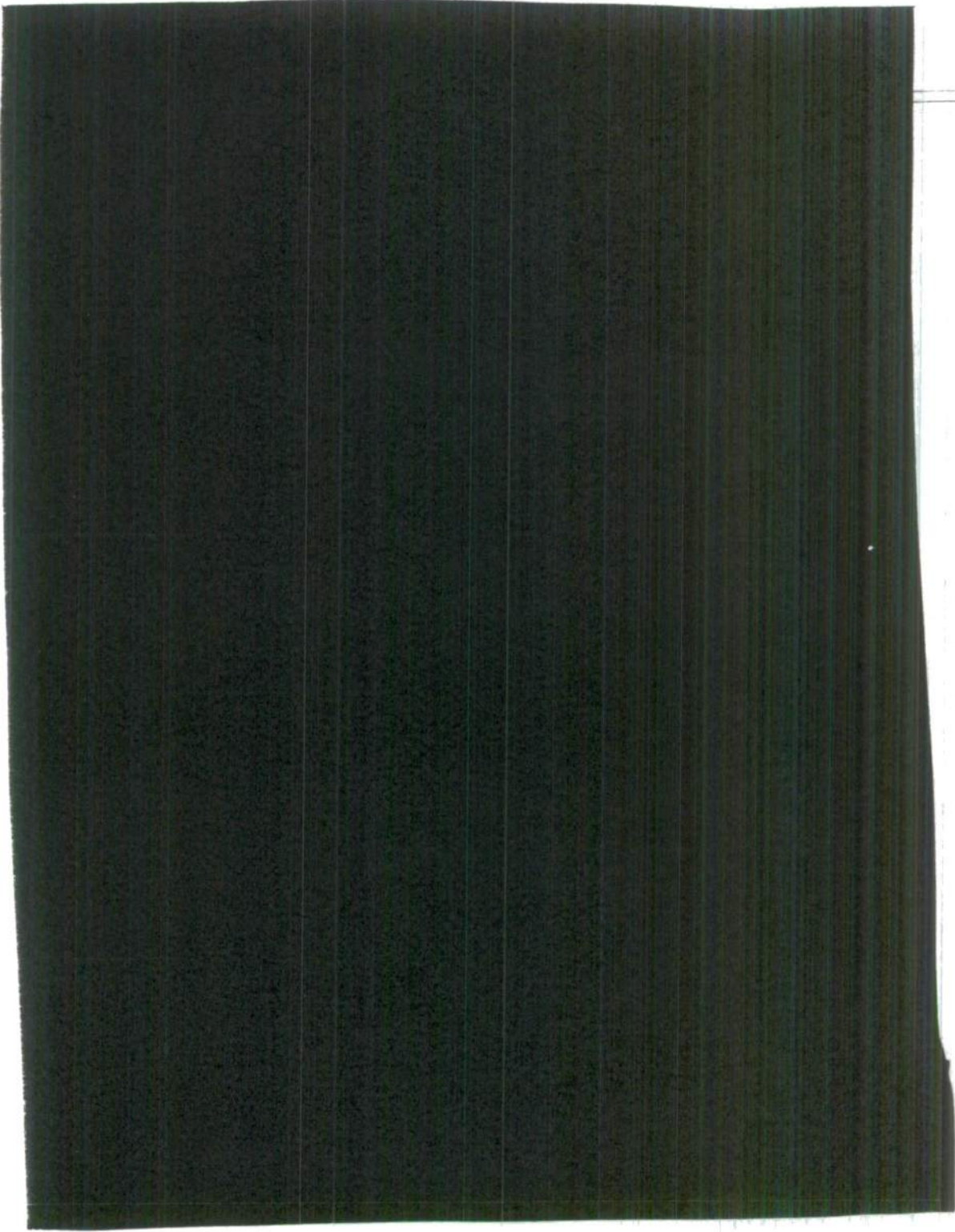
(S) Figure 15 shows a continuation of the Stage II and Stage III C-scope data obtained between [REDACTED] [REDACTED]. Throughout this interval, the LWIR radiation intensity levels of both the Stage III hard body and plume as well as the receding spent Stage II, remain relatively constant.

OSD 3.3(b)(4)(s)

~~Secret~~

~~Secret~~

OSD 3.3(b)(4),(8)



DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(b)

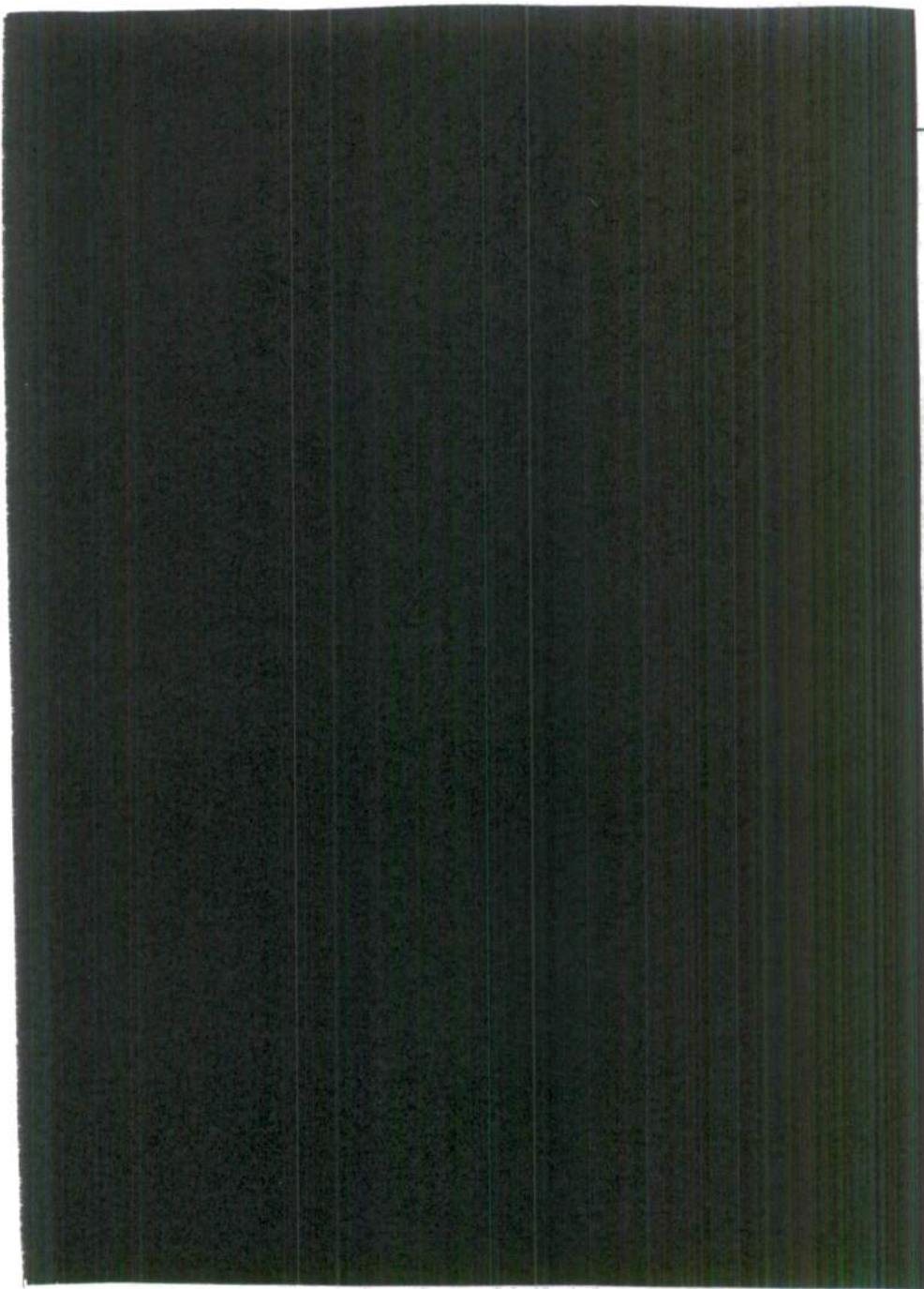
FIGURE 16

(S) Figure 16 presents additional frames of the Stage II and Stage III C-scope display data obtained between [REDACTED] [REDACTED]. During this coverage interval, the LWIR adiation of Stage II is rapidly decreasing in intensity and Stage III radiation is largely confined to the paraboloid shaped bow shock region of the vehicle. Extensive Stage III plume radiation is no longer apparent.

~~Secret~~

~~Secret~~

OSD 3.3(b)(4),(5)



DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4)(6)

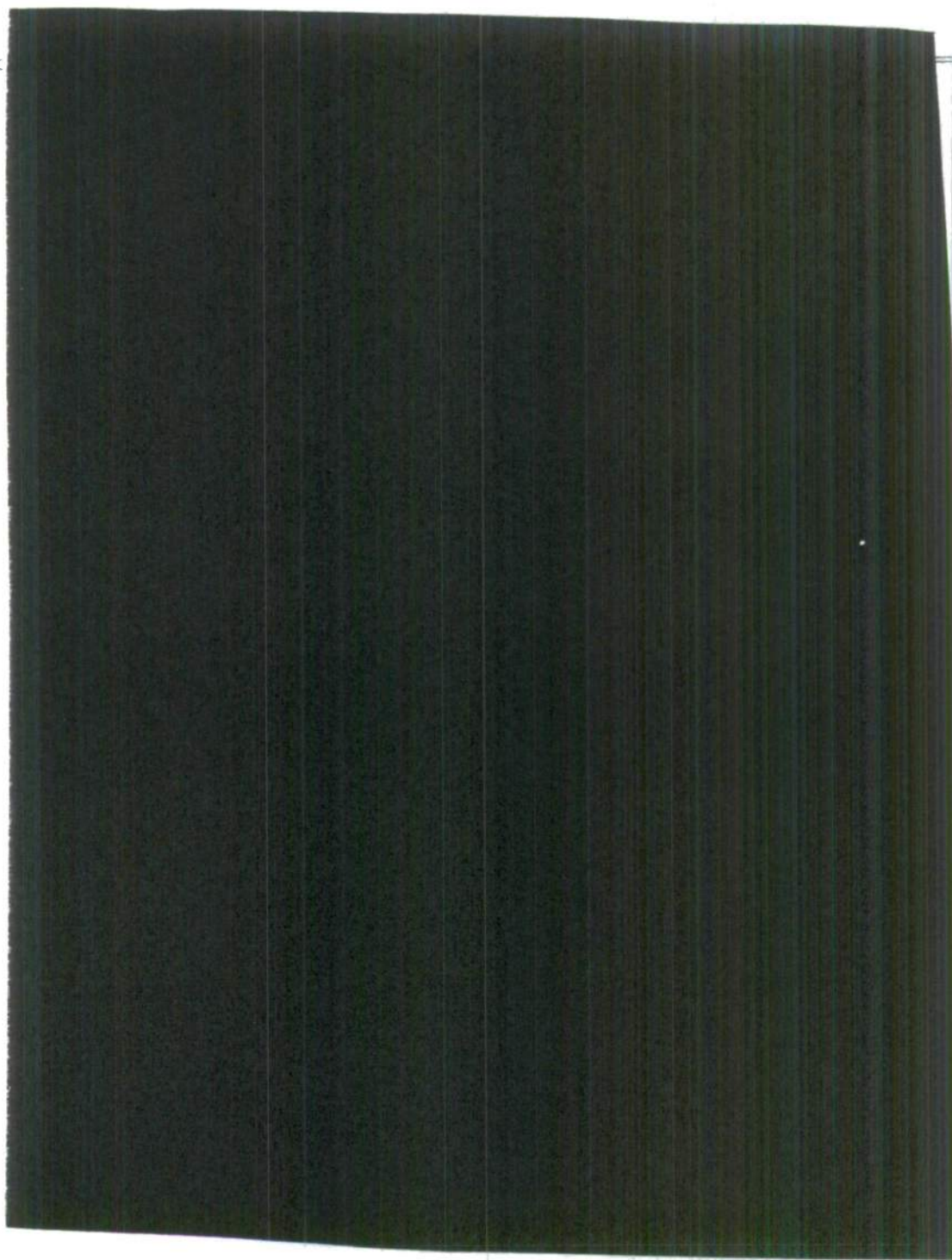
FIGURE 17

(S) Figure 17 presents the final sequence of C-scope display data, showing the decreasing LWIR radiation intensity signatures of both Stage II and Stage III from [REDACTED]. Lack of additional camera film presented further coverage of the C-scope display of the LWIR tracker data.

~~Secret~~

~~Secret~~

OSD 3.3(b)(4)(b)



DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~Secret~~

~~Secret~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

REFERENCES

1. Cotton, E. S., Presentation at Fifth Midcourse Measurements Meeting, Institute for Defense Analysis, Arlington, Virginia, (4 November 1969) SECRET.
2. Cotton, E. S. Presentation at Eleventh Midcourse Measurements Meeting, Aerospace Corporation, San Bernadino, California, (20 April 1971) SECRET.
3. Page, D. A., Presentation at Twelfth Midcourse Measurements Meeting, Supplemental Session, Naval Electronics Laboratory Center, San Diego, California, (13 July 1971) SECRET.
4. Cotton, E. S., Page, D. A., Sinclair, R. S., "Reentry Infrared Spectroscopy With An Airborne Tracking Telescope", presentation at Nineteenth National Infrared Information Symposium (IRIS), Office of Naval Research, Monterey, California, (2 June 1971) SECRET.
5. Cotton, E. S., Larrabee, J. F., Page, D. A., Powlette, D. D., "Wide Field of View Tracker Data WTR 3111 and WTR 2390" (U), AOR-11, Lincoln Laboratory, M.I.T., (24 August 1971) SECRET.
6. Anderson, M. C., Page, D. A., "Airborne Infrared and Visible Optical Data from WTR Test 2709" (U), AOR-12, Lincoln Laboratory, M.I.T., (24 August 1971) SECRET.
7. Bullwinkel, H. J., Page, D. A., Urbonas, A. J., "Airborne Infrared Optical Data from RVTO-2A-2 Mission" (U), AOR-13, Lincoln Laboratory, M.I.T., (24 August 1971) SECRET.

~~Secret~~

(This page is UNCLASSIFIED)

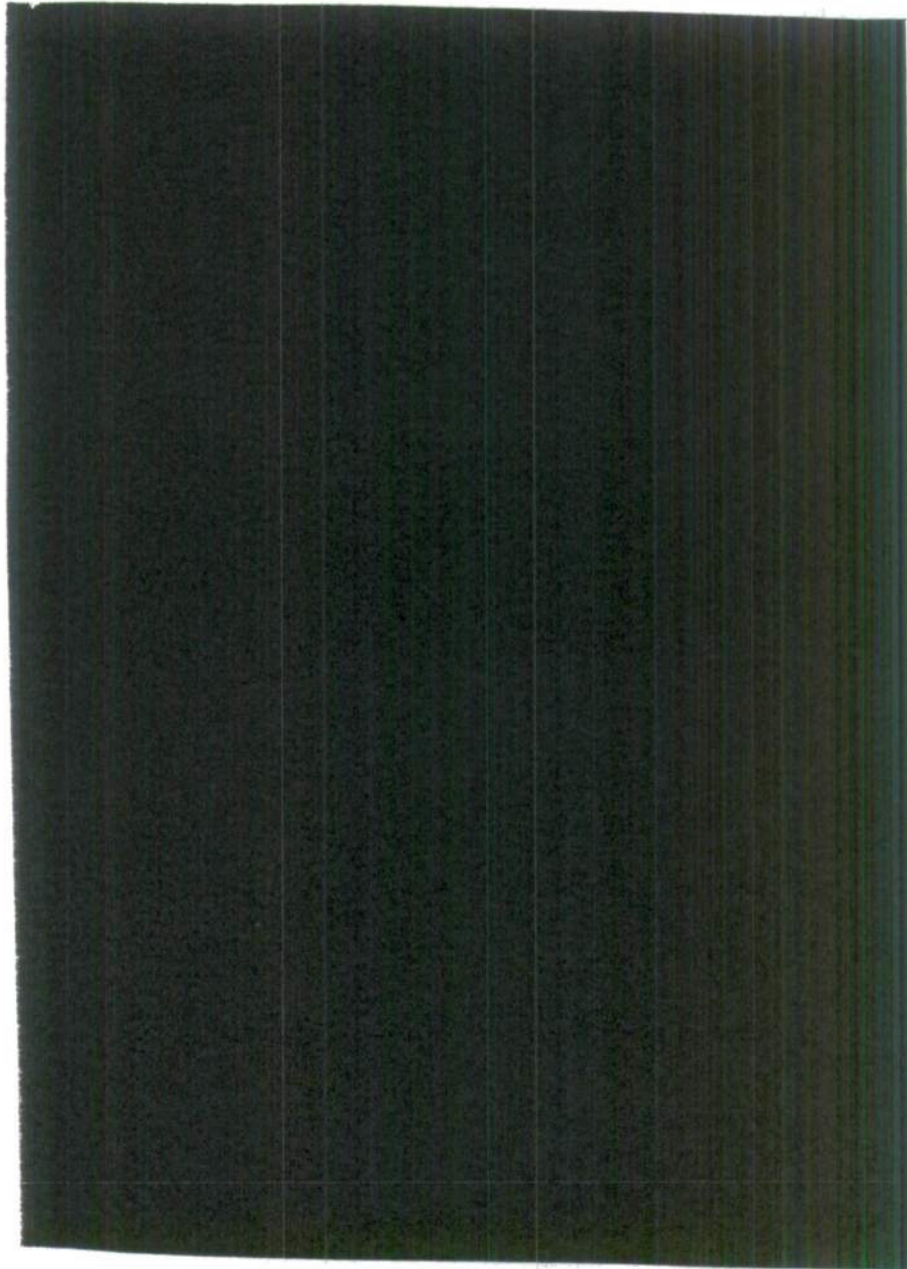
~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

OSD 3.3(b)(4),(8)

APPENDIX A

INSTRUMENT CHARACTERISTICS

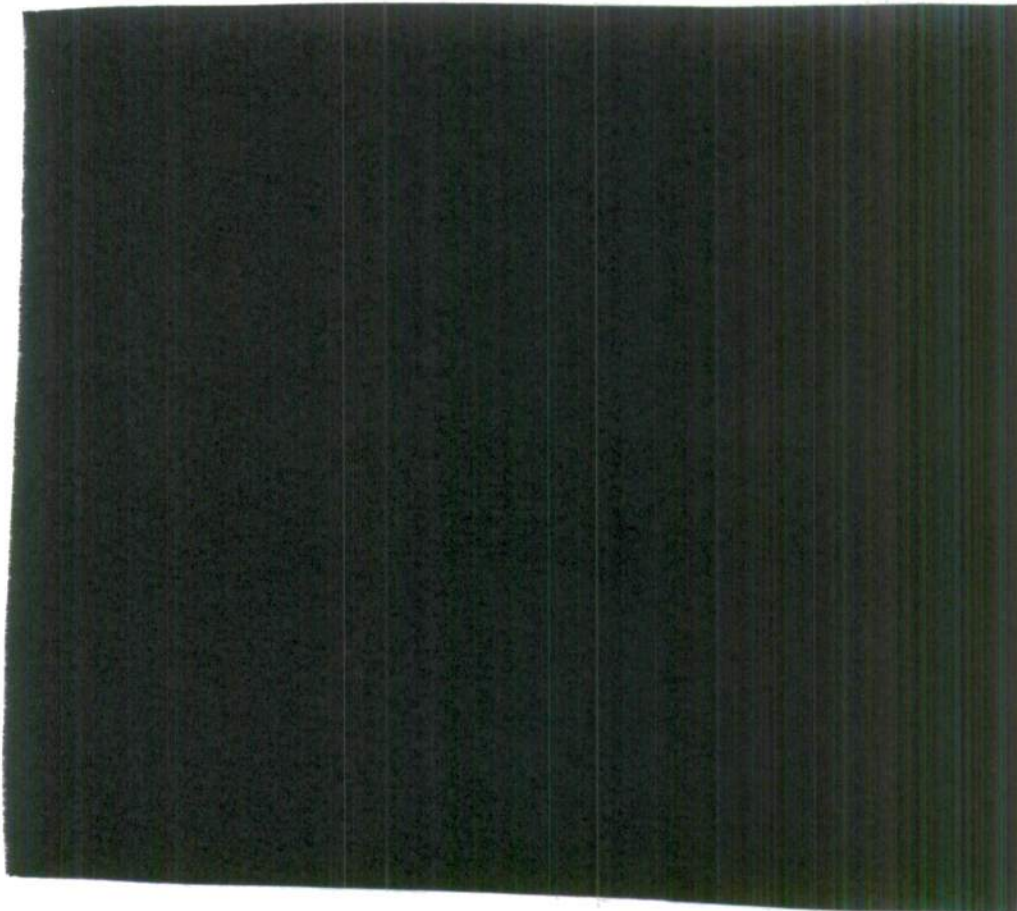


~~Secret~~

~~Secret~~

DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

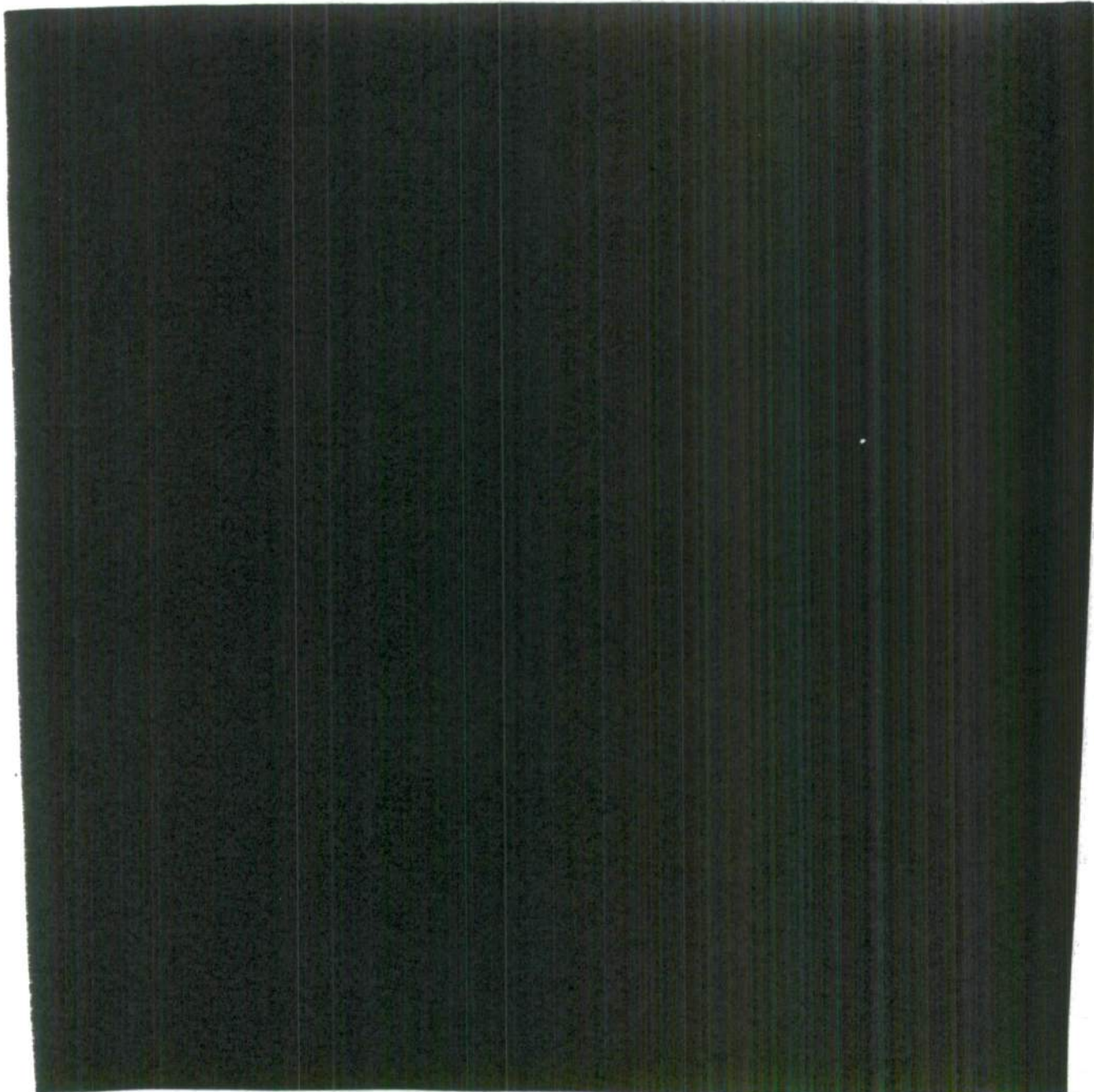
OSD 3.3(b)(4)(b)



Unclassified

OSD 3.3(b)(4)(b)

APPENDIX B (Continued)

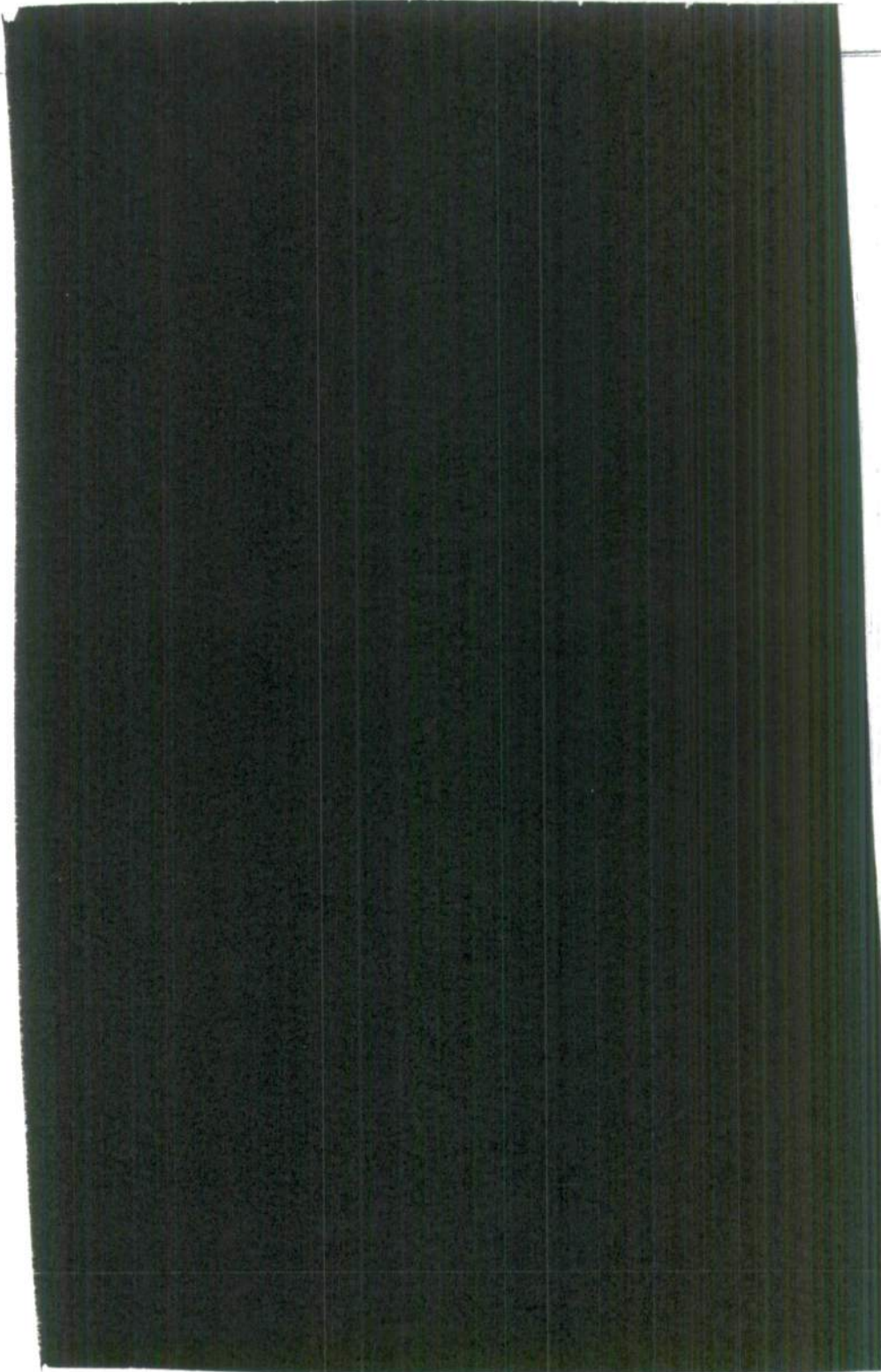


DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass. Div. WHS
Date: JUL 22 2013

Unclassified

Unclassified

OSD 3.3(b)(4)(b)



DECLASSIFIED IN PART
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

Unclassified

Unclassified

DISTRIBUTION LIST

ODDR & E
Washington, D. C. 20301

Attention of:

Mr. D. [REDACTED]

Mr. R. [REDACTED]

U. S. Army Research Office
Box CM, Duke Station
Durham, North Carolina 27706

Attention of:

Dr. [REDACTED]

Advanced Research Projects Agency
1400 Wilson Boulevard
Arlington, Virginia 22209

Attention of:

Program Management

Technical Information Office

Dr. [REDACTED]

Mr. [REDACTED]

Dr. [REDACTED]

Col. [REDACTED]

Maj. [REDACTED]

Commanding General
U. S. Army Missile Command
Redstone Arsenal, Alabama 35809

Attention of:

AMSMI-RNS

U. S. Army, Safeguard Systems Office
1320 Wilson Boulevard
Arlington, Virginia 22209

Attention of:

Mr. [REDACTED]

U. S. Army, ABMDA
Commonwealth Building
1320 Wilson Boulevard
Arlington, Virginia 22209

Attention of:

Dr. R. [REDACTED]

Dr. J. [REDACTED]

Dr. J. [REDACTED]

SAMSO, AFSC
AF Unit Post Office
Los Angeles, California 90045

Attention of:

Lt. Col. [REDACTED]

U. S. Army, ABMDA
P. O. Box 1500
Huntsville, Alabama 35807

Attention of:

RDMH- [REDACTED]

Dr. [REDACTED]

Mr. [REDACTED]

Mr. [REDACTED]

Hq. U.S.A.F.
Washington, D. C. 20330

Attention of:

Lt. Col. [REDACTED]

RDSD

OSD 5 U.S.C. § 552 (b)(6)

Unclassified

Unclassified

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JUL 22 2013

Air Force Office of Scientific
Research, U.S.A.F.

1400 Wilson Boulevard
Arlington, Virginia 22209

Attention of:

Dr. [REDACTED]

Air Force Cambridge Research Lab
L. G. Hanscom Field
Bedford, Mass. 01731

Attention of:
Scientific Library
CRREL, Stop 29

Dr. [REDACTED]

Dr. [REDACTED]

Dr. [REDACTED]

Dr. [REDACTED]

Mr. [REDACTED]

Rome Air Development Center, AFSC
Griffiss Air Force Base
Rome, New York 13440

Attention of:
RALS

Air Force Rocket Propulsion Lab
Edwards Air Force Base
California 93523

Attention of:

Dr. [REDACTED]

Capt. [REDACTED]

Capt. [REDACTED]

Air Force Avionics Laboratory, AFSC
Wright-Patterson Air Force Base

Ohio 45433

Attention of:

Dr. [REDACTED]

Lt. Col. [REDACTED]

Capt. [REDACTED]

Dr. [REDACTED]

Chief of Naval Operations
Department of the Navy
Washington, D. C. 20360

Attention of:

Commander [REDACTED]

Naval Ordnance Laboratory
White Oak
Silver Spring, Maryland 20910

Attention of:

Dr. [REDACTED]

Naval Research Laboratory
Washington, D. C. 20390

Attention of:

Dr. [REDACTED]

Defense Documentation Center
Cameron Station
Alexandria, Virginia 22314

(2 copies)

OSD 5 U.S.C. § 552 (b)(6)

Unclassified

Unclassified

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JUL 22 2013

National Bureau of Standards
Washington, D. C. 20234

Attention of:
Dr. [REDACTED]

Advanced Technology Laboratory
400 Jericho Turnpike
Jericho, New York 11753

Attention of:
Dr. [REDACTED]

AeroChem Research Labs, Inc.
P. O. Box 12
Princeton, New Jersey 08540

Attention of:
Dr. [REDACTED]

Aerodyne Research, Inc.
Technical Operations Building
South Avenue
Burlington, Mass. 01803

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]

Aerospace Corporation
El Segundo Operations
P. O. Box 95085
Los Angeles, Calif. 90045

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]
Mr. [REDACTED]
Dr. [REDACTED]

AVCO-Everett Research Laboratory
2385 Revere Beach Parkway
Everett, Mass. 02149

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]
Dr. [REDACTED]

Boeing Company
Aerospace Group
P. O. Box 3999
Seattle, Washington 98124

Attention of:
Dr. [REDACTED]
Mail Stop 14/25

Cornell Aeronautical Lab, Inc.
of Cornell University
4455 Genesee Street
Buffalo, New York 14221

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]
Dr. [REDACTED]

General Electric Company
Missiles & Space Division
Valley Forge Space Technology Center
P. O. Box 8555
Philadelphia, Pennsylvania 19101

Attention of:
Dr. [REDACTED]

65D 5 U.S.C. § 552 (b)(6)

Unclassified

Unclassified

Page determined to be Unclassified
Reviewed Chief, RDD, WHS
IAW EO 13526, Section 3.5
Date: JUL 22 2013

General Research Corporation
1501 Wilson Boulevard
Arlington, Virginia 22209

Attention of:
Dr. [REDACTED]

General Research Corporation
P. O. Box 3587
Santa Barbara, Calif. 93105

Attention of:
Mr. [REDACTED]

General Motors Corporation
DELCO Electronics Defense
Research Laboratory
6767 Hollister Avenue
Santa Barbara, Calif. 93107

Attention of:
Dr. [REDACTED]

Geophysics Corporation of America
Burlington Road
Bedford, Mass. 01730

Attention of:
Dr. [REDACTED]

Grumman Aerospace Corporation
Bethpage, New York 11714

Attention of:
Dr. [REDACTED]

Institute for Defense Analyses
400 Army-Navy Drive
Arlington, Virginia 22202

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]
Dr. [REDACTED]

Ling-Temco-Vaught Aerospace
1701 W. Marshall Drive
Grand Prairie, Texas 75050

Attention of:
Mr. [REDACTED]

Lockheed Missiles & Space Company
3251 Hanover Street
Palo Alto, Calif. 94304

Attention of:
Mr. [REDACTED]
Dr. [REDACTED]

McDonnell-Douglas Corporation
5301 Balsa Avenue
Huntington Beach, Calif. 92646

Attention of:
Dr. [REDACTED]

Physical Dynamics, Inc.
P. O. Box 604
College Park Station
Detroit, Michigan 48221

Attention of:
Dr. [REDACTED]
Mr. [REDACTED]

OSD 5 U.S.C. § 552 (b)(6)

Unclassified

Unclassified

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

~~SECRET~~

Polytechnic Institute of Brooklyn
Graduate Center
Broad Hollow Road
(Route 110)
Farmingdale, Long Island, N.Y. 11735

Attention of:
Dr. [REDACTED]

R & E Associates
P. O. Box 3580
Santa Monica, Calif. 90403

Attention of:
Dr. [REDACTED]
Mr. [REDACTED]

Riverside Research Institute
632 West 125th Street
New York, New York 10027

Attention of:
Dr. [REDACTED]

OSD 5 U.S.C. § 552 (b)(6)

TRW Systems Group
One Space Park
Redondo Beach, Calif. 90278

Attention of:
Dr. [REDACTED]
Dr. [REDACTED]
Mr. [REDACTED]

University of California
P. O. Box 109
La Jolla, Calif. 92037

Attention of:
Dr. [REDACTED]

Unclassified

(This page is unclassified)

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

[This page is intentionally left blank.]

~~SECRET~~

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

[This page is intentionally left blank.]

~~SECRET~~

~~SECRET~~

DECLASSIFIED IN FULL
Authority: EO 13526
Chief, Records & Declass Div, WHS
Date: JUL 22 2013

Distributed By

DTIC

Information For The Defense Community

~~SECRET~~

20090601152